

# CPAP / BiPAP

2011 Georgia Office of EMS Updates



GEORGIA DEPARTMENT OF  
COMMUNITY HEALTH

# DCH Mission

## ACCESS



Access  
to affordable,  
quality health  
care in our  
communities

## RESPONSIBLE



Responsible  
health planning  
and use of  
health care  
resources

## HEALTHY



Healthy  
behaviors and  
improved  
health  
outcomes

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# **DCH Initiatives FY 2011**

**FY 2011**

- Continuity of Operations  
Preparedness**
- Customer Service**
- Emergency Preparedness**
- Financial & Program Integrity**
- Health Care Consumerism**
- Health Improvement**
- Health Care Transformation**
- Public Health**
- Workforce Development**



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# Credits



Prepared By: Douglas County Fire Department

## Terms and Overview

- CPAP – Continuous Positive Airway Pressure
- BiPAP – Bilevel Positive Airway Pressure

CPAP and BiPAP are very similar. CPAP will be presented first, and the differences in BiPAP discussed at the end of this module.

- Consider CPAP a “bridge” airway device ideal for patients requiring more than supplemental oxygen, who are not sick enough to be intubated.
- Some people refer to CPAP as an “internal airway splint” since it’s primary function is to keep the lower airway open.

For many years providers have had to be creative in airway management techniques for those patients who need assistance in breathing, but are not yet sick enough for intubation. CPAP and BiPAP devices offer a reliable option for these patients.

## How CPAP Works

- CPAP provides the following:
  - Increases pressure in the lungs
  - Opens collapsed alveoli
  - Pushes more oxygen across the alveolar membrane
  - Forces interstitial fluid back into pulmonary circulation
- By keeping the alveoli open and pushing interstitial fluid into the pulmonary circulation, patients breath easier after the administration of CPAP.

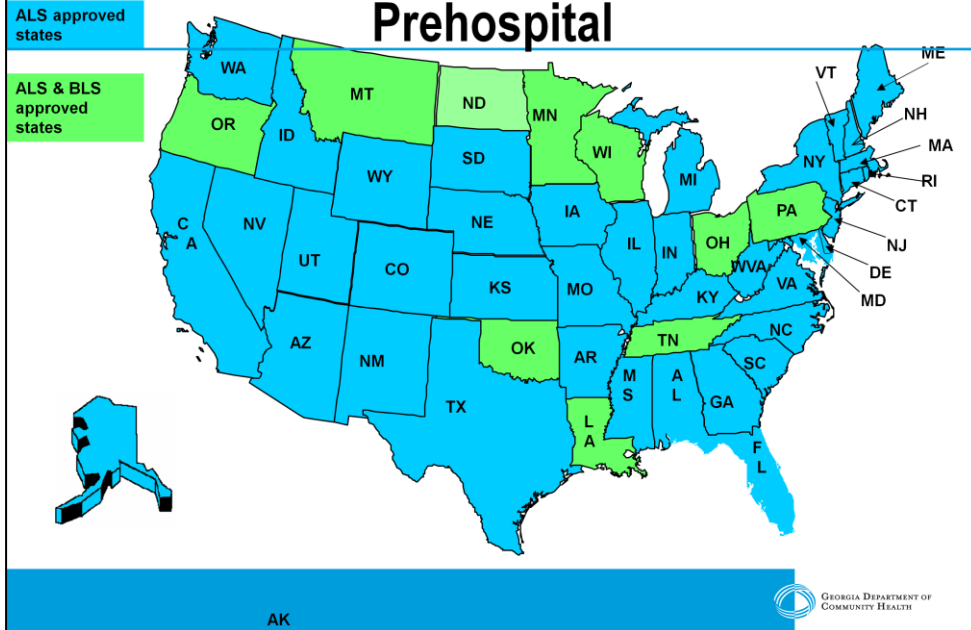


Continuous positive airway pressure devices work by maintaining positive pressure within the respiratory system. Typically when a patient exhales, the pressure within the lungs drops to a negative pressure and the alveoli collapse. Surfactant within the alveoli should keep the alveoli walls from sticking together and the alveoli should easily expand with the next inhalation. Unfortunately, when patients are struggling to breathe, both hypoxia and hypoperfusion decrease surfactant production and limit its ability to prevent alveoli collapse. As you can imagine, these patients will display an increase work of breathing as they attempt to re-inflate their alveoli to allow for gas exchange. Once the alveoli are open, CPAP maintains a positive pressure within the alveoli themselves, preventing them from collapsing each time the patient exhales. Since the alveoli are staying open during inhalation and exhalation, the time available for gas exchange within the lungs doubles, allowing more time for oxygen levels in the blood to increase, and more time for the patient to exhale retained CO<sub>2</sub>. CPAP also changes the pressure relationship between alveoli and the pulmonary circulation responsible for exchanging respiratory gases. As you can recall, patients who are experiencing pulmonary edema have fluid enter their lungs because the pressure within the pulmonary circulation is higher than the pressure within the respiratory system and fluid is following the “path of least resistance”. Although a simplified explanation, CPAP helps to combat an increase in pulmonary edema by creating pressure within the alveoli. This increase in pressure helps to push fluid already in the lungs back into circulation, as well as help prevent more fluid from entering the lungs themselves. You can research capillary hydrostatic pressure for a more thorough explanation of this

process.

OVERALL, CPAP WORKS BY: Increasing pressure within the alveoli and keeping them open, by increasing the time available for gas exchange, as well as the number of alveoli available to exchange these gases, and by creating pressure within the alveoli to push fluid back into circulation and prevent additional fluid from entering the lungs.

ALS approved states
ALS & BLS approved states



Currently, CPAP is approved for prehospital use in all 50 states, and the number of services utilizing CPAP in each state is rising. Many medical directors see the immediate benefits of starting a patient on CPAP as quickly as possible and trends indicate its usage will only increase.



## Patients Who Benefit From CPAP

- Respiratory distress patients can typically be broken down into three clinical areas:
  - Problems with ventilation Can't get air in
  - Problems with diffusion Can't get oxygen out of the alveoli into circulation
  - Problems with perfusion Blood not available to pick up oxygen
- CPAP works to improve respiratory distress for patients having ventilation and/or diffusion issues



When you evaluate a patient in respiratory distress, your patient will typically fall into one of three categories. Patients may be having a problem getting air into the alveoli, having trouble getting gases exchanged across the alveoli-capillary membrane, or they don't have enough perfusion to pick up oxygen in the lungs or remove carbon dioxide. Patients may even be having issues in more than one category at a time. Since CPAP works to open the alveoli and help with gas exchange, CPAP is beneficial for patients with both ventilation and/or diffusion issues.

## Indications for CPAP

- Remember, CPAP works by keeping the alveoli open and pushing out interstitial fluid.
- Examples of patients who can benefit from CPAP include:
  - Pulmonary edema
  - Congestive Heart Failure
  - Acute respiratory distress syndrome
  - Drowning
  - Pneumonia

**CPAP is to CHF like D<sub>50</sub> is to insulin shock**



Remember, any patient having trouble getting air into the alveoli and/or moving gases across the pulmonary-capillary membrane can benefit from CPAP administration. Look at the list of indications noted on this slide for a moment and think about what is actually occurring within the lungs themselves to create the patients respiratory distress. (PAUSE) As you probably concluded, all of these respiratory complaints place fluid in the lungs and/or decrease surfactant, causing the alveoli walls to stick together. For these patients having significant respiratory distress, CPAP is the answer.

## Indications for CPAP

COPD and Asthmatic patients do **NOT** respond predictably to CPAP.

They have a higher risk of complications such as pneumothorax, and thus the use of CPAP should be guided by local medical direction

Patients with COPD and Asthma have the potential for "Blebs". These blebs can rupture with an increase in intrathoracic pressure. Patients with a known history of "blebs" or a previous pneumothorax believed to be caused by COPD or Asthma should not have CPAP administered. Usage of CPAP for these patients should be at a lower pressure and this consideration addressed in local treatment protocols



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## Clinical Indications for Continuous Positive Airway Pressure (CPAP) Use:

- Any patient complaining of shortness of breath for the reasons other than pneumothorax AND:
  - Is awake and oriented and able to cooperate;
  - Has the ability to maintain an open airway (GCS greater than 10);
  - Has a respiratory rate high enough to effect minute volume (typically greater than 25 breathes per minute)
  - Has a systolic blood pressure above 90 mmHg;
  - Uses accessory muscles during respirations.



As healthcare clinicians, prehospital providers must look at the patients overall presentation to determine the best course of treatment for any patient. A provider cannot simply “cook-book” a patients treatment regimen, nor can we say all patients with the diagnosis of pneumonia, for example, require CPAP administration. Several guidelines are provided to indicate when CPAP would be beneficial for a patients care, but we must remember to look at the overall presentation of our patient.

When presented with a patient complaining of respiratory distress, ask yourself if the patient falls into the category of a ventilation or a diffusion problem. Although a pneumothorax falls into a ventilation problem, make sure this diagnosis is ruled out. The worst thing we can do for these patients is increase the pressure within their chest. Other than a pneumothorax, if the patient falls into one of these two categories, consider if the patient meets the guidelines for CPAP administration. Look at the list of “clinical indications” above. (PAUSE) Most of these guidelines indicate a patient who needs more than supplemental oxygenation, but are not quite sick enough to require intubation or ventilation.

## CPAP with Adjunctive Therapies

- Consider CPAP a tool to use in addition to other therapies to treat the underlying cause of the patient's respiratory distress.
  - Most brands of CPAP equipment offer the ability to administer a breathing treatment while continuing the use of the CPAP device.
  - Drug therapy may still need to be utilized to treat the underlying cause of the patient's respiratory distress.
- Local medical direction should determine how and when CPAP should be utilized within your treatment protocols



Consider CPAP a tool to use in addition to other therapies to treat the underlying cause of the patient's respiratory distress. For example, you may find a patient experiencing pneumonia may benefit from CPAP as well as a breathing treatment. The breathing treatment may help with bronchoconstriction, while CPAP opens the alveoli. Most CPAP circuits provide for a breathing treatment to be administered while CPAP administration is under way, so both treatments can be given at the same time. Alternatively, CPAP may be used as a treatment option prior to medication administration, such as you might see with congestive heart failure patients. Patients experiencing congestive heart failure may require the standard ALS drug regimen for CHF in addition to CPAP, or surprisingly, after several minutes of CPAP administration, the patient may not require any medication administration at all. The more familiar you become with CPAP, the better you will be able to integrate its usage into your everyday treatment regimens for respiratory distress patients.

## ***So, when can't we use CPAP?***



CPAP works wonders for many patients in respiratory distress, but like all treatments, they are not ideal for every situation, or every patient.

## Contraindications for the Use of CPAP:

Respiratory or cardiac arrest



Remember, CPAP **IS NOT** a ventilator, and only provides enough positive pressure to keep alveoli open when a patient is breathing on their own. Providers should monitor a patient's respiratory rate, effort, and depth and determine if a patient is able to breathe on their own, or if mechanical ventilation is necessary.

CPAP CANNOT (STRESS CANNOT) be used on patients in respiratory or cardiac arrest. These patients must be ventilated. Occasionally, patients who are on CPAP will deteriorate. Remember, these patients must be ventilated as well, and CPAP discontinued. This is one of the only situations in which CPAP should be removed from a patient once it is initiated in the prehospital field.

## Contraindications for the Use of CPAP:



Severely depressed LOC

In order for CPAP to be effective, patients must be able to follow commands and cooperate with the procedure.

Patients who are being administered CPAP must be awake and able to cooperate with the procedure. If a patient is severely altered, or becomes altered during CPAP administration, the patient should be ventilated.



## Contraindications for the Use of CPAP:



Low systolic blood pressure (typically < 90mmHg)

Remember, one of the functions of CPAP is to create positive pressure within the respiratory tract. In doing so, intrathoracic (pressure inside the chest) pressure is also increased.

Since venous return pressure must be greater than intrathoracic pressure for blood to return to the heart, patients who are hypotensive may not have enough pressure to overcome the increase in pressure CPAP is providing.

Remember earlier we said that patients need a systolic blood pressure of at least 90mmHg in order for CPAP to be applied? The reason for this is all related to pressure. As we increase pressure within the lungs, pressure within the thorax cavity is also increased. This increase in pressure must be overcome in order for blood to enter the thorax and return to the heart. If a patient is hypotensive, they may not have enough pressure to overcome the increased pressure in the chest caused by CPAP administration. Think about each component for a minute. (SAY SLOWLY)...Venous return pressure; which is the pressure pushing blood return to the heart; must be greater than intrathoracic pressure; the pressure inside the chest cavity, in order for blood to be able to enter the thoracic cavity. If a patient has low blood pressure already and we increase the pressure inside the chest, we are making it harder for blood flow to return and we can cause the patients blood pressure to drop even further. This is definitely not helping our patients ☹️

## Contraindications for the Use of CPAP:



### Signs of a pneumothorax

Patients with a pneumothorax already have a collapsed lung with air entering into the pleural space. As with positive pressure ventilation, CPAP can aggravate the pneumothorax, making the patients breathing difficulty worse. Signs/symptoms of a pneumothorax must be ruled out prior to the use of CPAP.

Again, patients with a pneumothorax **SHOULD NOT (STRESS)** have CPAP administered. As we all know, the problem with a pneumothorax relates to the collapse of alveoli in the affected lung as well as the excessive pressure entering the thoracic cavity. The last thing we would want to do is increase the amount of pressure building inside the chest cavity. Providers **MUST** rule-out the presence of a pneumothorax prior to the administration of CPAP.

## Contraindications for the Use of CPAP:



Pediatrics (age determined by local medical director)

Facial anomalies (burns, fractures)

In order for CPAP to deliver positive pressure, the mask must form a tight seal around the patient's mouth and nose. If you are unable to obtain a mask seal with any patient, discontinue the use of CPAP and select an alternative treatment therapy.

In order for CPAP to deliver positive pressure, the mask must form a tight seal around the patient's mouth and nose. Since most indications for CPAP administration are adult diseases, usually providers carry only adult size CPAP masks. If you are unable to obtain a mask seal with any patient, discontinue the use of CPAP and select an alternative treatment therapy. This applies not only to children, but also to patients with facial anomalies.

## Contraindications for the Use of CPAP:



Major trauma, esp. head injury with increased ICP or significant chest trauma

Air delivered under pressure can occasionally end up in locations that are not intended.

- Significant trauma may lead to pneumothorax, tracheal or bronchial tears, or esophageal rupture. CPAP could worsen these injuries.
- Air pressure generated during the use of CPAP could force air into the cranial vault. Caution is indicated in patients who may have increased intracranial pressure or those with a suspected basilar skull fracture.

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- Air pressure generated during the use of CPAP could force air into the cranial vault. Caution is indicated in patients who may have increased intracranial pressure or those with a suspected basilar skull fracture.

-Overall, contraindications of CPAP include: patients in respiratory or cardiac arrest, patients with an altered mental status who cannot follow commands, a blood pressure of less than 90mmHg systolic, signs of a pneumothorax, unable to create a proper face mask seal, or a patient with significant trauma, especially head or chest trauma.

## Precautions of CPAP



Use caution in patients with the following:

- Active upper GI bleeding or history of recent gastric surgery

Air can enter the gastrointestinal tract, leading to gastrointestinal upset.

- Complaints of nausea or is vomiting
- Inadequate respiratory effort

If you are considering CPAP, your patient already has an increase in respiratory effort. As a provider, you must determine if that effort is sufficient enough to attempt CPAP and monitor for improvement, or if immediate mechanical ventilations are warranted. If at any point during the use of CPAP your patient deteriorates, stop providing CPAP and move to mechanical ventilations.

- Excessive secretions



Remember the term “precautions” means be careful. Its not a “can’t use CPAP” clause, rather the provider must look at the overall picture to determine if the benefits of CPAP administration out weigh the risks of complications. As we’ve discussed, air will follow the path of least resistance, and sometimes this path leads to the patients stomach. As you can imagine, this may lead to gastric complications, especially for patients with stomach issues already.

Providers must also carefully, and frequently (STRESS) evaluate patients with inadequate respiratory effort. If you are considering CPAP, your patient already has an increase in respiratory effort most likely. As a provider, you must determine if that effort is sufficient enough to attempt CPAP and monitor for improvement, or if immediate mechanical ventilations are warranted. If however, at any point during the use of CPAP your patient deteriorates, stop providing CPAP and move to mechanical ventilations.



## Procedure



- Providers should become familiar with the equipment carried by their service.
- Be sure to explain the procedure to the patient.
- When available, place the patient on continuous pulse oximetry and waveform capnography. Ensure adequate oxygen is supplied to the ventilation device **prior to placement on the patient**.
- Place the delivery device over the mouth and nose. Secure the mask with the provided straps.
- Follow the manufacturers recommendations when selecting the liter flow per minute.
- Monitor the patient's respiratory response to the treatment and continue coaching the patient to keep mask in place and readjust as needed.
- If the respiratory status deteriorates, remove the device and provide BVM ventilation with or without endotracheal intubation.

Read the above slide as the procedure is demonstrated in the video 😊

## How Do You Know If CPAP Is Working?

- Patient's work of breathing is eased
- Improvement in respiratory excursion
- Increase in SpO<sub>2</sub>
- Stabilization of ETCO<sub>2</sub>



Once CPAP is initiated and during treatment, monitor your patient for signs of improvement. Look for the patients work of breathing to get easier, the ability of the patient to take a deep breath and fully expand his chest, an increase in SpO<sub>2</sub> and a stabilization in the patients ETCO<sub>2</sub>.

## CPAP vs. Intubation

### CPAP

- Non-invasive
- Easily discontinued
- Easily adjusted
- Minimal complications
- Does not require sedation
- Comfortable

### Intubation

- Invasive
- Intubated stays intubated
- Significant complications
- Can require sedation or pharmacological assist
- Potential for infection



CPAP offers us the ability to provide a non-invasive alternative to patients who are really struggling to breathe. CPAP is easily discontinued if the patient deteriorates and there are minimal complications that arise from its use. CPAP does not require sedation and is comfortable to most patients. You will notice in many treatment protocols CPAP used early is preferred to intubation and in many cases will even prevent the need to intubate your patient entirely.



## Why the push for prehospital CPAP?

- Improves patient outcomes.
- Offers a treatment solution for patients with respiratory distress, who do not require ventilation.
- Decreases the need for prehospital and ER intubations
  - Once intubated, the average hospital length of stay for a patient is 16 days
  - Prevents nosocomial infections secondary to ventilator assistance



So, why the push for CPAP? Well, the bottom line is CPAP improves patient outcomes and prevents the complications that can arise from intubation. CPAP offers a treatment solution for patients with respiratory distress who do not be intubated (as of yet). By decreasing prehospital intubations, we limit the possibility of complications, including nosocomial infections as well as decrease the financial burden of caring for these patients during a lengthy hospital stay.

## BiPAP

- BiPAP works similar to CPAP, but offers the ability to alter the pressure administered to a patient when inhaling versus exhaling.
- Most commonly you will see the use of CPAP in the prehospital setting. After blood analysis, respiratory therapy may opt to move the patient to BiPAP.
  - Trends however are always changing and the movement to prehospital BiPAP may be in our near future.



BiPAP, Bi-level positive airway pressure devices work similar to CPAP, but are not as prevalent in the prehospital setting as CPAP. BiPAP provides for positive airway pressures just as CPAP does, but allows the provider to alter the pressures administered during inhalation versus exhalation. In Georgia you will typically see CPAP administered prehospital and some patients moved onto BiPAP machines once further evaluations are conducted in the emergency department. Trends however are always changing in the prehospital setting and BiPAP may be in our near future.

## For More Information

If you are new to CPAP these links can provide you with additional information

[http://aironusa.com/wp-content/uploads/2011/02/JEMS\\_CPAP\\_2011-full.pdf](http://aironusa.com/wp-content/uploads/2011/02/JEMS_CPAP_2011-full.pdf)

[www.paramountems.com/.../CPAP%20for%20Medical%20Directors.ppt](http://www.paramountems.com/.../CPAP%20for%20Medical%20Directors.ppt)

<http://thorax.bmj.com/content/58/1/81.full>

<http://pats.atsjournals.org/cgi/content/full/6/4/367>



If your service is considering the use of CPAP, please spend some extra time learning the CPAP device carried by your service. The information provided in this presentation represents generic information not specific to any particular manufacturer or device. Above you will see several websites available that may offer additional information.